10 Mr. Borden,
With Mr. MacKenzie's Compliments

BETTER ROADS

AND

CHEAPER LIVING

AN ADDRESS BY

WILLIAM B. MacKENZIE, C E

MONCTON, N. B.

APRIL, 1913

When the smiles of spring appear,
Drag the roads;
When the summer-time is here,
Drag the roads;
When the corn is in the ear,
Every season of the year,
Drag the roads.

When you've nothing else to do,
Drag the roads;
If but for an hour or two,
Drag the roads;
It will keep them good and new,
Fall in line! It's up to you!
Drag the roads!

Curtis Hill.

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Better Roads and Cheaper Living

The Scientific American says that the road question is one of the biggest on the economic horizon today.

Good roads contribute to the glory of the country; they give employment to idle workmen; they distribute the necessaries of life, the products of the field, the forest and the factory; they encourage energy and make mankind greater and grander.

With good roads to connect the home, the school, the church and the Sunday-School, we would enjoy more of the pleasure to which we are entitled in this world, through which we pass but once.

This is an agricultural country, and we can better afford to improve our roads than not to improve them. If roads were in first-class condition at all seasons of the year, farmers could haul their products to market when prices were favorable, while now they have to market them when the roads are good, regardless of prices. Everyone knows that farm prices are lowest when the roads are in the best condition.

The prosperity of any country depends largely upon its transportation facilities, and the highways are the most essential part of the transportation system. In America we have been so busy building railroads for the last forty years that we have allowed our highways to go to destruction, and roads over which Her Majesty's mails were carried by four-horse coaches are now grass-grown. Where railroads have been in operation for 80 years, freight rates have fallen to one-tenth of the original charge; they will not go any lower, however, and the only reduction we can make is in the cost of hauling over our highways to the railway stations. In many places these roads are no better than they were 60 years ago; they are a disgrace to any country, and the cost of hauling over them is about 23c. to 25c. per ton-mile. In France, the cost is not one-half of what we pay, because the roads are good. In England it is 7c. per ton-mile. The people of the United States pay $500,000,000 every year for hauling over their earth roads, and because these roads are in bad condition, one-half of this large sum

of money is thrown away. Now that the country is fairly well supplied with railroads, the cry is "Back to the Highways." In the next twenty-five years there will be more activity displayed in improving highways than in building railroads. Many railroad engineers and contractors will become road-builders and their railroad experience will be of great benefit to both themselves and the public.

Early Roadmaking.

The earliest road builder in England of which we have any account was a blind man whom they named Blind Jack, the Roadmaker. His real name was John Metcalf. He did more wonderful things than any other blind man known to history, and among others became a contractor and built 180 miles of roads for $2,000 a mile. He became blind at six years of age. He seemed to learn and do things better than persons blessed with sight. He would walk over the ground along the line of road, make an estimate of the cost and say where the materials were to be procured. He would underbid other contractors, and do the work within the specified time. He could estimate the quantity of lumber in a tree by clasping his arms around it. He carried a long staff like a shepherd's crook and could tell where stone lay beneath the surface by listening to the sounds made by his staff on the ground as he walked along.

In Virginia, some of the roads were first built by money specially granted for the purpose by King George III. When the lines of these roads were blazed through the woods, with one eye on the line and the other on the lookout for the bloodthirsty red-man, three notches were made on the trees to indicate that this was the road of King George the Third. Afterwards, the King's highway, or a trunk road, was known as the three-notch road, a local road as a two-notch road, and a private road as a one-notch road.

In 1783 a man of independent means in England named Macadam began making a special study of road-building, and continued building broken stone roads for 43 years. He journeyed all over the Kingdom, paying his own travelling expenses, and the Government, in his old age, recognizing the good work he had done, made a special grant of $25,000 to reimburse him for the money he had spent in travelling expenses.

Macadam's short pieces of model roads, here and there, created a universal desire for better roads, and these same

roads having the "stitch in time that saves nine" applied to them in the way of repairs, are very much in evidence today. When some of my readers go over to England, to tour through that beautiful country in their own autos, perhaps they will remember that these roads were made by old men, women and children, who, sitting on stools, broke the stones on the sides of the road with hammers; the men using pickaxes dug up the old and large stones originally thrown there, while the women and children broke them up with hammers into small pieces, each piece weighing about 6 ounces.

When Macadam began, his specification was:—"Stones of a size which could be put in the mouth." It happened that one of the foremen had such a large mouth that he was using stones much too big; so Macadam changed his specification to 6 oz. stones.

There were no rock-crushers, grading machines, or road-rollers in those days, and it was truly "by the sweat of the brow" that improved roads became a reality.

If you were travelling on the country roads in England today, at every 3¾ miles you would meet or pass a traction-engine hauling a long train of wagons loaded with freight. These loads have now become so heavy that they expect to be compelled to build a concrete foundation under the Macadam to carry them. There are now 9,000 of these road traction engines on the common roads of England.

The annual license fees for motor cars in England are:—

Motor bicycles and tricycles	$ 5.00
Motor Cars up to 6½ H.P.	10.50
" " from 6½ to 12 H.P.	15.75
" " " 12 " 16 "	21.00
" " " 16 " 26 "	31.50
" " " 26 " 33 "	42.00
" " " 33 " 40 "	52.50
" " " 40 " 60 "	105.00
" " " Over 60 "	210.00

All this, together with a tax of eight cents per gallon on gasoline, is spent on the roads. The gasoline yields as much revenue as the car licenses.

English Scenery.

John Burroughs, one of the most charming of American writers, thus describes his first trip through the English countryside:—

"Those trees, those fields, that bird darting along the hedge-rows, those men and boys picking blackberries in October, those English flowers by the road (stop the carriage while I leap out and pluck them), the homely, domestic looks of things, those houses, those green vehicles, those thick-coated horses, those big-footed, coarsely clad, clear-skinned men and women, this massive, homely, compact architecture: let me have a good look, for this is my first hour in England and I am drunk with the joy of seeing.

As we sped through the land, the heart of England, I thought my eyes would never get their fill of the landscape, and that I would lose them out of my head by their eagerness to catch every object as we sped along. Now and then a brace or two of partridges, or a covey of quails would settle down in the stubble, or a pheasant drop head and tail and slide into the copse. Rabbits would scamper back from the borders of the fields into the thickets or peep slyly out. The birds are considered as the friends of the farmer, and their number is amazing. The roads are admirable. The whole of the landscape seems to have been finished with a brush and pencil, and even the hillsides look well-groomed. It is a garden, the living repository of the virtues of generations of gardeners."

Resistance.

Tractive resistance on roads varies from 20 pounds to 100 pounds per ton, depending on the nature of the roads surface. The average tractive pulling power of a horse is 35 to 40 per cent. of his weight.

For a hard road having 100 lbs. tractive resistance per ton we have $\frac{120}{100} = 1.2$ tons (including wagon) as the load for a 1200 lb. horse on a level. And $\frac{180}{1.20} \div 20 = 7.5\%$, the maximum grade that this 1.2 ton load can be hauled up.

A deep sand road on a level is equivalent to a 12% grade on a dry earth road. For a Macadam road having 40 lbs. tractive resistance per ton we have $\frac{120}{40} = 3$ tons (including wagon) as the load for a 1200 lb. horse on the level. Then $\frac{180}{3 \times 20} = 3\%$ which is the maximum grade that this 3 ton load can be hauled up. If a road is 10 miles long, a steep hill 9 miles from market, and another 1 mile from market, you should reduce the grade on the one nearest to market to 3%, because a larger traffic will go over it, and leave the further hill at 7%, because a smaller tonnage will go over it.

The latest experiments on tractive force are:—

Macadam, very good	38	lbs.	per	ton.
Macadam, average	46	"	"	"
Gravel, good	51	"	"	"
Oiled road, dry	61	"	"	"
Cinders, well packed	92	"	"	"
Earth, packed and dry	100	"	"	"
Earth, dusty	106	"	"	"
Oiled road, wet	108	"	"	"
Gravel, loose	147	"	"	"
Earth, muddy	190	"	"	"
Sand, loose	320	"	"	"

On a piece of level ground lay a steel track; put on it a wagon with a 3-ton load. Attach to the wagon a little pony having one-sixth the strength of a good horse; the pony will walk off quite comfortably with the load. The pony comes to the end of the track and meets a good Macadam road. There you will need a good strong horse, and you send the pony back home. The horse comes to a good gravel road, and there you will need another horse. The pair of horses come to a loose gravel or loose earth road, and there you will need five horses and a long whip. These five horses struggle along until they come to a loose sand or mud road, and there you will need 10 horses and a very long whip. Remember, that all these different kinds of roads were perfectly level.

Now, to illustrate the effect of hilly roads we will go back to the one horse load again. On a level, with our loaded wagon and one good horse, we get along nicely until we come to a place where the road rises 2 feet in 100 feet and there we want two horses. We go on with our two horses until we come to a hill rising 4 feet in 100 feet and there we need three horses. We go on with our three horses until we meet a hill rising 5 feet in 100 feet and there we need four horses. We go on with our four horses until we meet a hill rising 8 feet in 100 feet and there we need five horses. We go on with our five horses until we meet a hill rising 10 feet in 100 feet and there we need no fewer than six horses. These two examples of bad roads and hilly roads show the enormous excess cost of hauling on these roads over roads on a level.

Many of these hills can be avoided, and some of them will be, when we come to locate our highways with the same

care as we locate our railways. From 4 to 5 feet per 100 is the greatest rise allowable in the United States for improved roads, and as far as possible they are kept down to 1 and 1½ in 100—about the same as our railroads.

Effect on Farm Values.

The improvement of roads constitutes a most important factor in the enhancement of farm values, and a well kept farm located on a smooth, hard road, affording quick and easy access to markets, schools and churches, will not lack ready buyers at a good price.

States having the highest percentage of improved roads have the largest population per mile of road. Thus it is seen that serviceable roads are a factor in encouraging immigration.

Highway development is now as important as railroad development ever was. Why, in some districts bad roads have actually compelled people to abandon their farms. It has done so in many places of the United States, and if we inquired into the matter, I have no doubt but that a large number of the 860 abandoned farms of New Brunswick was caused by bad roads. Farm products are sold at the world's prices, and it is plain that where the roads are very bad, the farmers cannot compete in raising crops for sale, with places already provided with modern improved roads.

One of the chief beneficial results from good roads is that the farmer and others will be able to economize time and force in the transportation of products between country and market. The distance a farmer lives from market is not a question of miles, but of the roads he must travel over to reach that point. How many hours and how many horses does it require to haul a load to market? When thus measured, ten miles of good smooth highway are not as long as a few miles of mud and stone.

Farmers are realizing this more and more, that the distance they live from market is measured in time and not in miles.

It will be easily seen that any reduction in the cost of marketing a product is to the advantage of the country, for if the producer does not make the difference the consumer will; and it should not be, and it is not difficult to convince the town and city man that he is directly interested in the construction and maintenance of good roads in the country. If he can be convinced of this fact, he will be willing to be

taxed, that improved road construction may be carried on in every part of the country of which he is a resident. Wherever improved roads have been constructed, they have in a very short time demonstrated their value to the community, and have shown conclusively that they are the means of saving many dollars a year to the farmer. Over many public roads it is now impossible for a farmer to haul more than half a ton. It may be that considerable portion of the road between him and town may be a fairly good road over which he could easily haul a ton; but there are too many heavy places on the roads over which it is impossible to haul over half a ton. Consequently it is necessary for him to load his wagon for these rough, heavy places and not for the good places. If the farmer is not over eight miles from the railroad, his team can make a round trip in a day if the roads are not too muddy and there are not too heavy grades. If his team is worth $2.50 per day, it has cost him at the rate of 62½c. per ton for each mile. On the railroad it can be shipped to almost any point that the farmer desires for 1-50th to 1-100th of the rate which it has cost him to bring it to the railroad. This is because the science of transportation has been highly developed in connection with railroading and almost entirely undeveloped in connection with the public roads.

As public road improvement goes on, the farmer will find that he can begin to haul from two to four times as much per load as formerly, and in one-fourth to one-half the time, thus reducing the cost per ton per mile from one-fourth to three-fourths of what it cost him over the poor road. As we know, there is but little chance of reducing the railway transportation charge on agricultural products, but there is now a splendid opportunity to reduce the cost of the public road transportation charge on these products.

The estimated cost of transportation by horses and wagons, hauling one ton a distance of one mile on different road coverings:—

On iron rails	1.28	cents
On asphalt	2.70	"
On stone paving, dry and in good order	5.33	"
On stone paving, ordinary condition	12.00	"
On stone paving, covered with mud	21.30	"
On broken stone road, dry and in good order	8.00	"
On sand clay road, dry and in good order	8.00	"
On broken stone road, moist, in good order	10.30	"

On broken stone road, ordinary condition	11.80	cents
On broken stone road covered with mud	14.30	"
On earth with ruts and mud	39.00	"
On earth, dry and hard	18.00	"
On broken stone road, with ruts and mud	26.00	"
On gravel, loose	51.60	"
On gravel, compacted	12.80	"
On plank, good condition	8.00	"
On sand, wet	32.60	"
On sand, dry	64.00	"

Now, here is a little story of "Tax Rates and Economy", which will fit some parts of our country very well. In a certain place named "Hardscrabble", the roads are so bad that when a man goes out on horseback in wet weather he has to take along with him an extra mule to pull the horse out of the mud, and in dry weather the roads are impassable altogether, because you would choke to death with dust if you attempted to travel over them.

"If you say 'improvement' inside the borders of that township the people all cross their fingers and touch wood, and get pale around the gills, and holler "Tax Rate." And if anybody says that the roads ought to be improved or new culverts put in, the nayborrs hold an indignation meeting in the cimitary and pass resolutions denouncing the Socialists and Anarchists.

"And so they go on year after year, letting their fields go to the divil for lack of fertilizers, which can't be hauled to them, and letting their crops rot on the ground because they can't be hauled away. And their children can niver go to school and their women can't go to church, all because it costs money to put the highways in condition. But they keep the tax rate down 1-10000th of a cent lower than the rest of the country, which they consider proof conclusive of their good business management and official economy."

If the tractive resistance on a good earth road is represented by 1, the tractive resistance for 2½" of mud would be 2 . . . and for 6" of mud it would be 5, so that on this bad road your horse could handle only 1/5 of his load.

MASSACHUSETTS

In 1910 Massachusetts spent one million dollars on roads and one-quarter of it was from auto licenses where they [illegible] the whole traffic. There are [illegible] of

them now in this State (1912) and they run about 250 million miles per year. Their value is 90 million dollars, and the taxes and fines amount to two millions. The fees are $10.00 per car up to 30 H. P.

The Governor has recommended that the license be made $1.00 per H.P. Motor trucks are $5.00 per year, and this also will be raised. It costs 2½ times as much to keep the roads up to the same standard as it did before the auto came, and the Governor has recommended that one million per year for five years be spent on roads. The increased auto tax will actually benefit the auto owners by reason of the better maintenance of roads thus made possible. $1.00 per H.P. would only amount to 0.1 to 0.4 of a cent per car mile, or hardly ⅛ of the expense now necessary to maintain the rubber tires. A very slight increase in the life of the tires by reason of the good roads would more than offset the increased tax.

The road work of Massachusetts has been done more economically and honestly than that of any other State. The head is a commission of three business men of the highest standing and reputation for business ability and integrity, who are entirely free from political control, and who do their work on business principles. They receive $5000.00 per year each, and actual travelling expenses when on State business. Competent engineers are employed by them, and neither commissioners nor engineers are disturbed for political reasons. The commissioners are appointed by Governor-in-Council and serve for three years, one going out each year.

New York State.

Five years ago New York borrowed 50 million dollars on 50-year road bonds, and spent it. Last November the people voted 50 millions more, and they are now starting in to spend that. That State now has 100,000 licensed autos, which run 400 million miles per year, and this does not include foreign cars.

California has issued bonds for 18 millions; Maine 2 millions, following the construction methods of Massachusetts. Pennsylvania will issue 50 millions of bonds in 1913. The agitation for better roads in all the States is very great. These 50 year bond terms are too long. What would you think of a man who would buy a coat and give a note for it, to be paid by his son a quarter of a century hence? The coat would be worn out possibly before the son was born.

and so would the road. Let the bonds be no longer than 15 years, and protect them by a sinking fund; then make the road taxes to correspond.

A scheme has been started among the United States auto manufacturers, dealers and auto supply firms, to set aside one per cent. of a year's gross earnings for a ten million dollar fund towards building an ocean-to-ocean macadam road; the money to be presented to the counties through which the road will pass. At the end of 1912 one million had already been collected, and not a cent will be spent until the whole ten million dollars is guaranteed.

Amount spent on roads:—

	1910	1911	1912
Pennsylvania		$11,500,000.	Now proposes to spend 50 millions
Texas		7,000,000.	In 1912 12 counties issued bonds for 2¼ millions, and 5 millions in all were spent.
Michigan		6,000,000.	
California $1,350,000		7,000,000.	
Ohio		6,600,000.	Now proposes to spend 50 millions
Oregon		1,500,000	
Maryland		1,250,000	
New Jersey 1,000,000			1/3 from State.
New Hampshire .. 740,000			
Delaware		300,000	

Georgia built 4,344 miles of good roads in 5 years and employed thereon 4,500 prisoners.

Connecticut has spent 10 millions in 16 years, mostly in reducing grades, filling low places, underdraining foundations, retaining walls, etc. This is done under one commissioner.

In all the States on the 2¼ million miles of roads, there were spent in 1912 $150,000,000, on trunk line roads:—

$22,000,000 were from State Aids.
20,000,000 were from Local bond issues.
108,000,000 were from Local revenues.

In two years 34,000 miles of improved roads were constructed in the United States, and there are now 400 million dollars' worth of road bonds issued.

The Province of Quebec in 1911 spent $250,000 on roads, and the municipalities as much more. They are now starting to build a colonization road 140 miles long, and they will spend a much larger sum this year of 1913 building a road from Montreal to Rimouski, 325 miles, Montreal to Sherbrooke 90 miles, and from Montreal to Rouse's Point 45 miles. One half of the latter is already complete. The municipalities pay $1000 per mile. The Government has ten road making plants and lends them to the municipalities in charge of a Government inspector. One plant consists of: —

1 15 to 18 h.p. engine.
1 stone crusher, 10 to 15 tons per hour.
1 elevator.
1 12-ton roller.
1 sprinkling wagon (300 gallons).
1 road machine.
1 road plough.

When a municipality spends $1000.00 the Government will give a subsidy of $500.00.

The road between Montreal and Rouse's Point is called the King Edward road, and by the time it is completed the Americans will meet them with their State road from New York. When New Brunswick builds a good road from St. John, up the valley of the St. John River, across by Lake Temiscouata, and Quebec builds down to meet it, you can then take your auto and enjoy a trip to New York by way of Fredericton, Lake Temiscouata, Riviere du Loup, Quebec, Montreal, Lake Champlain, Saratoga, Albany. To persons who have read Parkman's Early History of Canada, such a trip from the St. John Valley to the Hudson River Valley would be one of the events of a lifetime.

Quebec has now borrowed 10 million dollars for roads on 41 year bonds, and the municipalities can borrow from the fund at 2% interest.

Ontario in 1910 spent $553,312, of which the municipalities paid $368,875 and the Province $184,437.

In 1911 old Ontario spent $711,000; Province 1/3, Counties 2/3. In 1912 Ontario built 240 miles of macadam roads, spending $1,400,000. Province spent 1/3, Counties 2/3. The municipalities spent in addition in those two years $2,500,000.

Since the autumn of 1911, eight trunk roads radiating from the City of Toronto from 2 to 11 miles out into the

country have been built by the City subscribing $100,000, the County of York $100,000, the Provincial Government $100,000.

The cities are realizing that their interests extend out into the country far beyond the city boundaries.

British Columbia has spent in the last ten years $15,000,000 on roads and bridges. In 1912-13-14, it will spend $5,000,000 per year.

Saskatchewan has appropriated $5,000,000 for trunk roads and is spending one and a half millions this year (1913). This is all in addition to $400,000 usually spent each year.

Alberta has appropriated $1,000,000 for a trunk road in 1913, in addition to $250,000 from current revenue. Edmonton will spend $1,000,000 on roads in 1912. In this Province they pay their convicts 50c. per day for work on the roads and not one has escaped.

A new scenic highway is projected from Edmonton to the new National Park at Banff, 580 miles.

Manitoba has set aside $200,000 per year and is issuing 50-year debentures.

New Brunswick spends annually $100,000 on roads. A new road Act has recently passed the Legislature.

Nova Scotia spends annually $200,000 cash and $250,000 in statute labor.

Prince Edward Island spends now, annually, $55,000.

In the nine Provinces, on 250,000 miles of road, $10,000,000 per year are now spent.

Bridges.

Regarding bridges, the Engineer of Highways for Ontario says in his 1911 report:—

"The number of steel bridges in the Province that are "too light, badly designed, poorly riveted, carelessly erected "and rapidly rusting to ruin for lack of painting, is already "too numerous."

It costs $10,000 a year to paint the Brooklyn suspension bridge, and before the painting gang has reached one end of the bridge it is time to begin at the other end.

It is estimated that on one large railway alone 18 tons of metal a day are destroyed by rust. The rate of rusting is about 50% per year after the first year. The shop painting of steel bridges for ordinary spans is a delusion: let the steel alone until it is erected, then paint it properly.

Down here by the sea we know what rusting means. We also know what it means to build concrete piers and abutments in salt water, where the surface between high and low tide will distintegrate at the rate of a half an inch per year. Make a piece of concrete, and let it thoroughly set in air. Put it under water and very soon it will be completely saturated, and its strength diminished 40 to 50%. I have been observing this destruction of concrete in salt water by wetting and drying, freezing and thawing, for several years, and I feel safe in saying that a comparatively inexpensive protection for similar concrete structures will be brought into use in the near future.

I have seen new members being put in a steel bridge after 10 years' use; the original members being rusted to the danger point. Steel bridges cost a lot of money, about $22 to $25 per lineal foot for 100-foot spans, and they should be as carefully looked after, by cleaning and painting, as a man would look after his gold watch. Less than this is not good business, and is a discredit to those who are responsible for the maintenance of these bridges.

The labor for cleaning and painting is about four times the cost of the paint, and there is therefore no excuse or justification for using anything but the very best paint known.

In 20 years Ontario has spent $40,000,000; about $21,000,000 in cash and $19,000,000 in statute labor. Some of this work consisted of throwing the loam, sods and dust out of the ditches on to the middle of the road and leaving it there in lumps; the same as we do here, and which would ruin the best road ever built. This waste is now almost stopped in Ontario, and in a short time we hope to see all the road taxes collected like any other tax, and properly spent under competent engineers, experienced in location, drainage and construction of roads, bridges and culverts. When this time comes, farm lands bordering on these roads will increase in value from 50 per cent. to 300 per cent. The cost of transportation to market will be cut in two, and the present isolation of farm life will be largely overcome. Our young people will be induced to stay at home, instead of going [illegible] West, working 12 or 15 hours a day all summer and staying idle all winter, or spending the time in collecting and burning poplar firewood to avoid freezing to death. Of course, no one in this country would think of trying to burn poplar, but there in many places it is poplar or nothing. We have all

heard too much of the dreadful loneliness of the unending, rolled out flat prairie.

A New Brunswicker said to me: "We camped one evening at a certain spot on the prairie. A half mile off we saw a small shack and in front of it a man in his shirt sleeves and without a hat. He started running towards us and presently was hidden behind a clump of low bushes. After a time we looked for the man, but he was nowhere to be seen. We called; no reply. On turning around I saw his head peering out from a clump of bushes on the other side of the camp. We shouted an invitation to come and join us at supper. He came slowly out and sat down by our fire. He ate supper with us, but answered questions only in monosyllables. After a time he lay down and we all fell asleep. When we woke in the morning he was gone. We saw him plowing in the field as we prepared to leave; but as we came towards him he again disappeared. That poor man had been living out there all alone for no one knows how long, and had been slowly but surely losing his reason, from pure loneliness, and there are hundreds like him."

Another said: "I had a crop three years ago; none since; not enough rain one year, and a hail storm the next. I hope to have a crop this year. You know the showers follow the valleys and streams and between it is as dry as Sahara. Why don't you leave? No money; I am hoping to sell out to some other fool."

"The distant hills always look blue," but every country has some disadvantages. They lost 30 million dollars' worth of orange trees in California, Monday, January 6, 1913, and it takes eight years to raise an orange tree.

Here we have neighbors, schools for our children, churches galore and some other things which keep many other people contented and happy, and which enumerated are:—An election, a religious revival, or a fight. In fact, I have it on newspaper authority that the people in the part of the country where the sun rises, will at any time, day or night or on the Sabbath, stop everything or anything, even eating, drinking and sleeping, to talk politics.

These things, together with some farming and struggling over our roads knee-deep in mud, spring and fall, keep us fully employed, and our reasoning powers so active that we are not in any such danger of losing the little sense we have, as was the poor lonely man on the prairie.

You can go to many parts of the Maritime Provinces today, and buy for $2.00 a barrel better flavored cooking-apples than ever grew in the Okanagan Valley. Not long since a person said to me: "I have been all over the West, and I can buy five times more fruit land in the Cornwallis Valley, for the same money, than I can in the west, and I can live more comfortably."

From the figures I have given, you will have observed that the Maritime Provinces do not compare favorably with those farther West, as to the yearly expenditure on roads. In the next few years it will be said "By their roads ye shall know them.'

Nova Scotia has done well in the last few years, and she will do better year by year, with money economically expended under competent supervision, utilizing the gravel, the sand and the clay which is scattered all over the country.

There are so many thousands of miles of roads in Canada, and the land is producing such a small fraction of its possible output that we will never see all our roads paved; but we will see many of them treated in some cheaper way, to decrease the cost of hauling.

No farming community is so poor that some sort of a good road will not prove to be a wise investment.

We must recognize conditions as they exist, and meet them in a practical way, otherwise our talking will do no good.

The money spent on our country roads is not enough, and it is useless to talk about better roads unless we can get more money and skilled supervision. We must pay more road taxes and the money must be properly expended.

The Dominion Government is now pledged to assist the Provinces, and no proposition which could possibly be conceived of is better calculated to improve the condition of the people of Canada and lower the cost of living, than the proposition to improve the common roads, under a proper system of supervision and maintenance.

Sir Horace Plunket, member of the British House of Commons, and the world's leader in the agricultural co-operative movement, said on the 13th day of this month (January, 1913), in an address at Madison, Wis., where he is visiting, that the farmers of America were largely responsible for the high cost of living; because they failed to co-operate in reducing the cost of distribution, and in eliminating the middleman.

"The cost of distribution!" That means, in part, the cost of hauling over our bad roads. "Chickens usually come home to roost," and the blame is now being put where it belongs. What is needed now, is organization on this road question, with a determination to reduce the cost of living, by reducing the cost per ton-mile of getting the produce from the farm to the railway station or the market, over a good road; and when the farmers are properly organized, the middle man, too, will disappear.

Rome failed because her people ceased to produce; because agriculture was not nourished; and because the speculators and middlemen were allowed to rob both the farmers and the consumers.

The first step towards reducing the cost of living in this country is better roads, the next, organization and cooperation between farmers and consumers.

Sixty-three per cent. of our people are engaged in agriculture and ninety per cent. are dependent on agricultural pursuits.

The Louisville & Nashville Railroad Co. has printed and distributed a lecture by D. W. King on "How to have good dirt roads." The Company believes that better country roads are essential to the development of the traffic upon which the financial success of their railroad depends. If this be true of that particular railroad, it should be true of every trunk railroad in this country. This expert asserts that where land is worth $30 00 an acre, and sand and gravel and clay can be procured within three miles, the community which does not improve its roads, is not making the most of its opportunities. Where land is worth $100.00 an acre, it will pay to ship road materials 100 miles by rail.

Ninety-two per cent., or two million miles of the United States highways are still unimproved.

Is it not reasonable to suppose that if all the roads radiating from the cities and towns for 20 miles in every direction were real good roads, that we could buy our farm products at cheaper prices than we can now? All farm produce would cost us less, because it would cost the farmer less to produce it and to haul it over the roads, and he would make just as much money as he does now, and there would be less talk of putting all the taxes on land, as a single tax, and making the other fellow pay most of it.

A road is like a house; it must have a good foundation, and to have a good foundation it must be dry. What is the

good of a house cellar if the water stands in it a foot deep, and what kind of a road can we expect to have if the sub-grade is saturated with water, when the frost goes down 4 or 5 feet and expands it 1 to of the volume of water in it. Unless the water is first taken away from the road entirely, better leave the road as it is. The actual wearing surface or veneer of the road is the least important: the drainage and the foundations are the essential parts.

Roads should be fitted to the necessities of traffic, the means of the community, and the materials at hand. It is better to have a patch fail in a road three miles long, than to have one mile of road no part of which can fail. To make one mile of road as perfect as a city avenue, and have no money left for the other two miles, would not be good engineering, or even good common sense.

The Macadam type of road is well adapted to trunk roads connecting centers of population on which there is a large travel.

This kind of road will cost from $3,000 to $5,000 per mile, acording to the amount of bridging and the number of waterways required. Roads less travelled may be surfaced with gravel. These will cost from $500 to $1,500 per mile. Sand-clay roads furnish an economical form of construction where stone is not obtainable. These will cost the same as gravel roads.

Location and Survey.

In some cases on hills, the road should be diverted, and the top reached on an even grade and more circuitous route, thus reducing the grade to, say, 5 to 7 per cent., allowing heavy loads to be hauled and making it easier to control the storm water which always rushes down along the middle of the road when it comes straight down the hill on a steep grade.

Heavy grades also become covered with ice in winter, making it dangerous to descend and difficult to ascend with loaded vehicles.

In Nova Scotia they have improved the grades of some of their roads at from $200 to $300 per mile and some hilly roads have been graded down at a cost of $3,000 per mile. The Auto Club of Halifax gave $1,300 in 1910 to improve a road leading out from Halifax.

Surveys should be made with transit and level, and plans and profiles made, the same as for a railroad. Run in straight lines and true circular curves with the transit, and

set grade stakes with the level. All streams, culverts, bridges and drains should be located on the plans and their clear openings marked: those which will last for five years should be marked "good"; those which will last less than five years, to be marked "bad." The character of the present roadbed should be noted on the plan at every 100 feet, such as rock, clay, sand, sand and clay, gravel, etc. All gravel pits, clay deposits, field-stones, quarries within one or two miles of the road should be noted, and places where water can be had for watering carts on the roadside should also be noted.

Plans, Profiles, Specification, Cross Sections and Estimates.

There should be made:

A plan on a scale of 100' to 1".

A profile on a scale of hor. 100' to 1"; vert. 10' to 1".

Cross sections on a scale of 10' to 1".

The cross sections should show both the old and the new elevations at the centre of the road. Standard drawings should be made for all required structures. In the United States no wood is used.

Soundings should be made with an iron bar or test pits dug to ascertain where the rock is, in places where the hills are to be cut down.

When the work begins, the road engineer should set grade-stakes or plugs every 50 feet along the road, and on each side of the road, just outside the line of the top finish, the top of each stake being level with the crown. By stretching a string across from stake to stake he will have no difficulty in making the crown uniform.

For trunk roads, a determined attempt should be made to keep the grades under 5 per cent., where such can be had without too great cost for cutting and filling, or for property damages.

Drainage.

The most important part of the road work is the drainage, and no water should stand within two feet of the crown of the road. The surface water must flow quickly from the rounded road surface into the side ditches and be carried away with the least possible delay, and the water must not remain under the road. The road must be crowned or rounded towards the centre so that there may be a fall of one inch per foot, from the centre to the sides, that

the water may flow rapidly into the side ditches On Macadam roads the crown may be less than on gravel roads or sand-clay roads. On hills, the crown should be 1½" per foot, to prevent water from running down the centre of the road. The water should be carried in the side ditches no further than is necessary, because the side ditches are eroded by the water and deep gullies are formed, particularly on grades.

Where this is liable to occur, the side drains should have pipes 6" diameter covered with large stones, and these pipes should be carried to a proper outlet; either a culvert or by an offtake ditch through the fields to some natural water course.

The side drains should be two feet below the crown of the road. Turn as much of the water as possible away before it reaches the road by making catch-water ditches when practicable. The best grade for side ditches is 6" in 100'; because if they are flatter than this, the snow will hold the water back in winter and cause trouble. Where tile drains are necessary to lower the water level, use 5-inch tile 3 feet under the side ditches.

The ditches should be kept running free in the spring, so that the water may run off in a hurry; because if the cold water is not drawn off quickly, the bed under the centre of the road will not drain as the frost comes out; but will remain wet and soft and allow the wheels to cut down into it.

Side drains are the key to the situation just at this time.

The water should run across the road to the ditch, and not along the road in the wheel tracks. Culverts must be kept clear in the spring freshets.

Roads are often lower than the surrounding lands, so that the road becomes a natural ditch built by man for acres and acres of surrounding country. The road should be at least a foot higher than the surrounding country and 2' above the bottom of the side ditch, and if it is perfectly under drained, it will not heave with the frost nor become water soaked in summer. Before the frost can heave it, the voids between the particles must be 9/10 full of water; then the expansion by frost—250,000 lbs. per sq. in.—will be 1/10 of the volume of the water

Culverts.

For culverts, salt-glazed vitrified clay pipes are cheapest up to 2½ feet diameter. Above that size and up to 5 feet diameter, Toncan metal is cheapest. The price of a 2'

foot Toncan metal pipe 12 gauge is $2.35 per lineal foot and for a 5 foot pipe 10 gauge the cost is $6.45 per foot at the factory in Oshawa, Ont., in carload lots. These pipes are of very pure iron, they promise well as to durability, and are certainly most convenient in use, being divided longitudinally and nested into each other for easy transportation. A metal has recently been discovered which is rustless: it is a combination of pure iron and molybdenum.

Fences.

Road fences of wood are going out of use and are being replaced with wire. Wood fences cause the snow to bank up on the roads and keeps them wet much longer in the spring. Wire fences are improving the roads wonderfully. When a creosoting works is established somewhere in the Maritime Provinces, probably in Halifax, it will pay to creosote fence-posts, street paving blocks, telephone poles, and many other structural timbers.

Stone Roads.

For ordinary country roads, experience has shown that the broken stone way need not be more than 12 to 15 feet wide, if suitable shoulders 3 to 5 feet wide are built on each side of the stone. The modern practice is to make the macadam surface as thin as possible, yet with sufficient body to stay in place, the theory being that the macadam is only a wearing surface. Three inches of macadam after rolling, is the least thickness which is practicable and, except in unusual cases, a depth greater than 6 inches after rolling is rarely necessary, if the foundation is suitable. The material of the foundation is of much importance. It should be composed of porous material free from clay or loam and sufficiently strong to sustain any load likely to come upon it.

The principal qualities necessary in road-building stones are hardness and toughness. Trap rock has long been considered the best material for macadam purposes; but in certain localities, these stones are not common. Stone from the ledge, because of its uniformity in desirable qualities, is usually better than field stone, and makes a smoother and more durable road: but if the ledge is of an inferior grade of rock, it should not be used merely because it is ledge, in preference to field stone of a better quality of rock.

The average cost of 10 macadam roads in New Jersey was $8,350 per mile in 1910. Grades were reduced in every

case and none are now over 6 feet in 100 feet. Maintenance is $200 per year. Washington $5,000 per mile. Ohio $5,750 per mile, Virginia and Maryland $3,100 per mile, for new stone roads.

At Bergen, in Norway, there is a splendid driveway called the "Drink Road"; because it is constructed wholly out of the profits from the sale of liquor. The municipal government has the sale of liquors entirely in its own hands. It decides how many licenses are needed, and then instead of giving them to private individuals, it grants them only to a responsible stock company. The books are always open to inspection under the Government control. The company is not allowed to make more than five per cent. on its invested capital, and all profits over that are given to public improvements, roads, parks, schools or hospitals. This law has been in force for 13 years at Bergen and all the towns in Norway except three now have followed the example. The people are delighted with the law. The liquors are selected. The bars are not attractive gin-palaces; only plain rooms. There are no seats for customers. There is no loitering. Only a small quantity is sold at one time. Children are not allowed to serve as messengers. The bar-tenders are appointed by the municipal government, and wear a uniform and a number by which they may be identified in case of complaint.

The quantity of liquor sold has decreased from 12½ to 5½ million quarts annually. The Bergen company has earned a net profit of 125 per cent., 120 per cent. of which is applied to public charities.

I think you will all agree with me that if we must drink liquor in this country, we cannot do better than follow the lead of little Norway, for they seem to have sense enough to make the liquor traffic build their roads. What better ending could there be for the stuff which is causing so much misery in the world than to thus stamp it beneath our feet back into mother earth from which it came?

125 per cent. clear profit on rum! No wonder liquor-sellers become rich and liquor-drinkers become poor in mind, body and length of days. We pass this way but once, taking 43 years, on an average, to do it, and to deliberately shorten our time is cowardly. The Norway law is worth thinking about, for every third man over there lives to be 70.

The child of a drunkard is not necessarily a drunkard; but the probability is that he will inherit a tendency in that direction. Scientists now tell us that if this tendency to

drink liquor is resisted for three generations, it will entirely disappear in the fourth. When this happens we will have plenty of road money.

The United States people spent enough in liquor last year to build the Panama Canal, and Canadians, probably, about as much, in proportion to numbers. The workers of England drink up one Dreadnought a week—10 million dollars! What would this waste not do if properly spent!

A bill has been introduced in Washington which proposes to levy a special small tax on smokers and users of tobacco, as a road tax, and it will produce 80 million dollars a year.

In California	there are	60,000	auto	licenses.
" Washington	"	"	12,000	"	"
" Oregon	"	"	6,500	"	"
" Idaho	"	"	1,000	"	"
" Nevada	"	"	650	"	"
" New Brunswick	"	"	700	"	"
" Nova Scotia	"	"	997	"	"
" P. E. Island	"	"	....	"	"

There are fifty thousand autos in Canada (February, 1913), forty thousand of which came from the United States, and for these eighty million dollars were paid, besides twenty million dollars duty.

Tools and Machinery.

In addition to the shovels, picks and other ordinary implements of construction, a considerable outlay for machinery is necessary. Portable stone crushing outfits may be bought at prices ranging from $1,000 to $2,500 and are well adapted for country use. From 80 to 100 tons (60 to 80 cubic yards) of broken stone per day may reasonably be expected, if the plant is kept in good condition. Steam road rollers are now used to a great extent. Macadam roads may, of course, be built with rollers drawn by horses. There are several excellent makes of steam rollers which may be had at prices ranging from $2,500 to $3,500. Since water is always needed in rolling macadam, a water cart or sprinkler should be provided, with a capacity of from 450 to 600 gallons. A road machine is a most serviceable implement in shaping and repairing earth roads and in preparing the foundation for macadam roads. The importance of proper grades and drainage for all roads has already been mentioned. It is not

enough that the roadway for a macadam road shall be graded with reasonable care.

The surface upon which the broken stones are to be placed must be hard, smooth, and carefully crowned. If the foundation is not hard and firm, the stones will be pressed into it by the roller, and wasted. Usually a trough-shaped section is made, sufficient material being left on the sides to form shoulders for the macadam. After the roadbed is shaped to the approximate cross section, it should be rolled thoroughly, until it is hard, firm and smooth.

Stones ranging in diameter from 1¼" to 2¼" should be spread first for the lower course, to a depth which will allow for a shrinkage of 35 per cent. under the roller. When 100 feet or so of the first course of stone has been spread, the rolling should begin.

It will be found best to begin the rolling at the outer edge of the macadam, running up on the shoulders a few inches. The second course, consisting of stones varying in diameter between ½ inch and 1¼ inches should be spread and rolled as was the lower course. After the stones are thoroughly compacted the binder should be spread. The top course is usually a little more than one inch in depth in 6-inch work. The water cart should then be put on in advance of the roller, and as much as possible of the dust flushed into the interstices between the stones. The roadway should be wet and rolled until it puddles on the surface, showing that the voids are substantially filled.

All the trees which are ornamental, or which are of value as shade trees, should be preserved and protected. They are a considerable factor in reducing the cost of maintenance, since they lessen the evaporation of the moisture from the macadam. They add greatly to the attractiveness of the road. A good arrangement for trees with large tops is to set them about 50 feet apart on each side of the road, but alternated, so that there will be a tree every 25 feet along the road.

In the Province of Hanover 7,000 miles of country roads are bordered with fruit trees, from which $595 per mile per year is obtained, and this money is put into the general road fund. The trees are pear, plum, cherry and apple trees.

To travel over these roads is like journeying in fairy land. The birds nest and sing in the branches and treat you to a concert of sweet sounds.

A writer says:—

"He who plants a tree by the wayside may never see its "abundant foliage, except in his imagination, and those who "enjoy its welcome shade in future years, may never know "to whom they owe it; yet he has filled a real need, and creat- "ed a real happiness, the very possibility of which should be "at once his inducement and reward."

Van Dyke has said, "He who planteth a tree is a servant of God."

Tars, oils, and various other substances are increasing in use for road-surface application. These preparations are intended to fix the wearing coat upon the road to prevent dust and to form a waterproof coating. Owing to the increasing use of motor vehicles, treatment of this kind seems essential to preserve the wearing surface of roads where there is much of this sort of traffic. The tar and oil are sprinkled upon the road hot; generally a layer of sand or screenings is scattered on the top. The tarred roads are hard, smooth, and resemble asphalt, except that they show a more gritty surface.

Maintenance.

Some one has said that the maintenance of a macadam road should begin on the day the road is completed, and this is true of all types of roads. The mistake is often made of building a fine road and then allowing it to go to ruin. It is usually not necessary to do much to the macadam surface for a year or two, except to fill any small holes or incipient ruts which may occur. It is well to have piles of material for mending the road placed at convenient intervals along its length.

Hard Roads.

Gravel Roads.

Although it is impracticable, and in many cases impossible, for communities to build good stone roads, a surface of gravel may frequently be used to advantage, giving far better results than could be obtained by the use of earth alone. Seaside and river gravel, which is composed usually of rounded, water-worn pebbles, is unfit for surfacing roads. It has no angular projections or sharp edges, and will not bind together. Inferior qualities can sometimes be used for foundations, but where it becomes necessary to employ such material, even for that purpose, it is well to mix just enough sandy or clayey loam to bind it firmly together. For this

wearing surface or top layer, the pebbles should, if possible, be comparatively clean, hard, angular and tough, so that they will readily consolidate, and will not be easily pulverized by the impact of traffic, into dust and mud. They should be coarse, varying in size from half an inch to an inch and a half.

The best gravel for road-building stands perpendicular in the bank: that is when the pit has been opened up, the remainder stands compact and firm, and can not be dislodged except by the use of a pick, and, when it gives way, falls in solid masses. Such material usually contains tough, angular gravel, and may be placed on a properly prepared road-bed without further treatment.

In constructing a gravel road, the roadbed should be first brought to the proper grade; ordinarily, an excavation is then made to a depth of 8 to 10 inches, varying in width with the requirements of traffic. The surface of the road bed should have a fall from the centre to the sides, the same as that to be given the finished road, and should if possible be thoroughly rolled and consolidated until perfectly smooth and firm. A layer of good gravel not thicker than 6 inches should then be spread evenly over the prepared roadbed. Next, a roller should be used. If the gravel is too dry to consolidate easily, it should be kept moist by sprinkling. As soon as the first layer has been properly consolidated, a second, and if necessary, a third layer, each about 6 inches thick, is spread on, and treated in the same manner until the road is built up to the required thickness and cross section. The last, or surface layer, should be rolled until the wheels of heavily loaded vehicles passing over it makes no visible impression.

In some places manure spreaders have been used to spread gravel on the road, the beaters being removed and the machine driven at the speed necessary to give the proper thickness of gravel.

The economical distance for removal of material by different methods is:—

Hand shovels	12 feet.
Wheelbarrows	150 "
Drag Scrapers	200 "
Wheeled scrapers	500 "
Dump carts	600 "

Over 600 feet, dump cars on a track. When these are not available, use 1½ c. yd. Troy dump wagons up to 1500 feet, and beyond this use train-haul.

Earth Roads.

Owing to the absence in many sections of the country of rock, gravel, or other hard substances with which to build durable roads, and because of the excessive cost of such material, where it is transported from a distance, the majority of our public highways are necessarily earth roads. The split-log drag has been of great service in the improvement of earth roads. This simple implement is made of the halves of a split log, framed together by wooden braces about three feet in length, so that the split surfaces of the log shall be in front. The face of the drag lies at an angle of 45 degrees with the line of the road, thus drawing the earth towards the centre. The rear log should follow the track of the first. Drags should be used just after rains or continued wet weather, to smooth the earth surface and prevent ruts from forming to hold the water. The drag not only smooths the road, but crowns it and puddles the mud so that it is hard when dry. These drags have been used with success on clay or water-holding soils, and many sections of rural roads are maintained by the use of this implement alone.

Every farmer should own one, and after a rain he should spend a few hours dragging the road adjacent to his farm. If there are many depressions to fill in, the drag should be used when the road is wet, but after it has made the road fairly smooth it gives the best results if used after the earth begins to dry. All stumps, roots, vegetable matter, rocks, etc., should be first removed from the surface and the holes filled in with suitable material. The width of the travelled way should depend upon the requirements of traffic and should ordinarily be from 12 to 18 feet.

During 6 to 10 months of the year a good earth road suits the farmers better than any paved road. It is easier to ride over. A horse can travel farther and easier on it, and it will last longer. Shoes cost less. A horse or an auto will prefer the earth road if both are in good condition and running side by side. It is springy and gives a good grip to the tires. It does not produce the same jar as a paved roadway does.

Sand-Clay Roads.

In many parts of this country, natural sand-clay roads may frequently be found in localities where the soil contains the right proportions of sand and clay. In sections of the country where the prevailing subsoil is composed entirely of clay, or, on the other hand, is of an extremely sandy character, these materials may be properly mixed so as to overcome the objectionable features of each, provided the material to be added is conveniently available.

Sand-clay roads are well adapated for light traffic, and when the cheapness of this kind of construction is considered, it will be seen that for certain localities it is preferable to macadam. The best sand-clay road is one in which the wearing surface is composed of grains of sand in contact in such a way that the voids or angular spaces between the grains, are entirely filled with clay, which acts as a binder

If natural drainage does not exist, artificial methods must be used. The best natural drainage is usually upon a loose gravel or sandy soil. If the land is dry and the sand deep enough to absorb quickly the heaviest rains, no special attention need be given to drainage of sand-clay roads, other than to provide the proper crown to the surface of the finished road to divert the water from it. The road-bed should first be crowned as nearly as possible to the form desired in the finished road. If the clay is to be placed upon sand, it will be found more economical to crown first a section of the road nearest the source of the clay. The first load of clay is dumped on this prepared section at the point nearest the clay bed, each succeeding load thus being hauled over the preceding. The materials should not be mixed in a dry state; but, on the other hand, they should be thoroughly mixed and puddled with water. This is most easily brought about after a hard rain, the clay having been previously spread and the larger lumps broken up. The surface should then be covered with a few inches of sand and plowed and harrowed thoroughly by means of a turning plow and a cutaway or disk harrow. If the sand is to be placed on a clay subsoil, the clay surface should be plowed and harrowed to a depth of about four inches, and then covered with about 6 or 8 inches of sand. Upon the completion of the mixing and puddling, the road should be shaped while it is still soft enough to be properly finished with a scraper, and at the same time stiff enough to pack well under the roller, or under the action of traffic.

In one place in Kansas the sand was so fine and there was so much of it that in a dry time it was a heavy drag for a team with an empty wagon to get through it at all, and with a load, necessitated not less than four horses, and the journey had to be made by very slow stages and the horses rested every few hundred yards. The road was put in good condition by shaping the bed, hauling and distributing clay and mixing and rolling the surface at a cost of $800.00 to $1000.00 per mile.

In another place in Kansas 50 bushels of wheat was a load for four horses. After improvement with clay, the load has been doubled and autos run 40 miles an hour.

The average haul of the clay was three miles. It is maintained by a King drag at a cost of $5.50 per mile per year.

In Syracuse on an improved sand-clay road, the loads hauled have been trebled.

The cost of an improved sand-clay road is from $700 to $1184.

California now has the best sand-clay roads in the world. When they discovered that they could make good roads from sand and clay alone, San Diego County Highway Commission at once issued bonds for 1¼ million dollars to build 448 miles of boulevards on this system. In one place there happened to be a deposit of decomposed granite like fine gravel; this was used with clay, tamped with the petrolithic tamping roller and dragged. It was so smooth that the boys put on roller skates and skated to school, and they are doing it yet.

In Virginia they use light grey sandy soil, and by dry mixing clay with it, after thorough rolling, make a water-tight road.

Quality of Clay.

Plastic clay is best for road-making. It should slake slightly and have sufficient binding power to cement the grains of sand.

It should have little shrinkage and should fill the voids in the sand and no more. If the clay balls up, add more sand. If the surface loosens in dry weather, add more clay; usually 20 per cent. clay to 80 per cent. sand.

The sand and clay should not be mixed in a dry state, but should be thoroughly mixed and puddled with water. If an excess of clay is used, the grains of sand which are not in contact are free to move among and upon each other, so

that no particle exerts more resistance to pressure than if the entire mass consisted of clay alone. On the other hand, if an insufficient amount of clay is used, the mixture will lack binding power and will soon distintegrate.

The color of the best clay is usually red or mottled red and white. Air-dried clay contains 20 per cent. of water of combination, which can only be driven out at a very high temperature.

The average cost of sand-clay roads in the Southern States for the covering alone from 12' to 16' wide 6" to 9" thick is $650.00 per mile.

What cuts many of our roads to pieces as fast as they can be repaired is the fact that the sods and stones are thrown up into the centre of the road and the grader is used to cover this trash up with earth and smooth it over, with the result that after a heavy rain, the dirt washes off the top of the sods and stones and leaves them exposed in the middle of the road. As this makes such bad going for horses, the road is practically divided in two, people driving to the right and left of this centre strip of rough sod and stone, with the result that the vehicles always being on an angle, the wheels nearest the ditch are constantly breaking down the shoulder of the road and pushing it into the ditch.

Another of the most effective agents for the destruction of all kinds of roads is narrow tires. 5-inch tires are more easily pulled than 2-inch tires over all classes of roads, except in mud from 2" to 6" deep, and even then there is only a difference of 10 per cent. between a 4" and a 1¾" tire

The sooner we use broad tires, the sooner will we have better roads, and the broad tires will help to keep them so.

For a wt. of 2000 lbs, including wagon, we need a 2½" tire.

do	4000	do.	do	do	do	4 "
do	8000	do.	do	do	do	4½"
do	16000	do.	do	do	do	5 "

A new road machine has recently been invented by W. K. Stebbins, manufacturer, Fairmont, N. D., and put into use in that State. It is a combination roller and scraper. The weight of the machine itself is 550 lbs. Roller 750 lbs. Rear weights 800, in all 2200. Cost $100. About 5 miles of road can be put in good condition in a 10 hour day; 4 horses are used. Assuming three miles per day as an average day's work, the cost of road maintenance would be about $2.00 per

mile per year. This is for earth and clay roads 16 feet wide with light grades. It is an improvement on the split-log drag and bids fair to come into very general use

Another machine which would be very suitable for the gravel-earth or sand-clay roads of this country would be the petrolithic rolling tamper, which is a roller weighing 4700 lbs, having teeth, or feet as they are called, 9 inches long. These feet are shaped something like a sheep's foot, and they penetrate into the material and consolidate or tamp it from the bottom up, and it is rolled back and forth until the teeth ride on the surface and refuse to penetrate any more. Water must be used from a sprinkler while the tamping is in progress. The road is then smoothed with a drag, and we have 9 inches of thoroughly tamped water-proof material. It is drawn by four horses and does much better work than the heavier smooth roller which tamps only the upper two or three inches of the material. The cost, together with that of other machines used on the best sand-clay roads of California, are as follows:—

(1) A gang rooter plow for tearing up the old road $408.00.

(2) A spiked disc harrow for breaking up the large pieces, $178.50.

(3) A rolling tamper, the grader to follow the tamper to keep shaping it up as the tamper compresses it, $765.00.

(4) 20th Century grader for mixing the clay and sand and for shaping up the road, $150.00.

The above prices include duty delivered here.

Many of our bridges would not carry a 12-ton roller; but these heavy rollers are not needed on highway work, for recent experiments made with a pressure gauge have proven that the pressure beneath a roller varies inversely as the cube of the depth of the earth below the face of the roller, so that the theory of the toothed roller is scientifically correct.

DRAGGING.

Wheel tracks soon form after the road is finished. If these are promptly filled with a drag and again forced down by the wheel tires, this part of the road becomes thoroughly consolidated, and the result is two lines under the wheels which are as hard as solid stone. This is the key to a good road, simply keep the wheel ruts filled up, and smooth, by

the drag; the wide tires will do the rest. The sides or shoulders near the ditch will become sodded, and these sods must on no account be put on the centre of the road, as is usually done by the grading machine. Either throw the sods across the ditch, or use them to fill up some hole at the foot of a hill.

Use the same material to repair a road as was used in its construction. When you fill a hole in an all-sand road, use sand, and when you fill a hole in an all-clay road use clay If you use sand to fill a hole in a clay road, two holes will be formed. Fill the holes up at once, and crown them a little to allow for settlement; give them the "stitch in time." Mow the weeds on and cut out the sods from the shoulders by an occasional use of the grader.

Split-Log Drags.

A simple split-log drag can be built for $2.00. Suppose every farmer had one and would drag the road in front of his own property twice a week and after every rain. It might take him half an hour to one hour each time. It is surprising how good the road may be kept by using the drag, after it is once put in shape. Holes should be filled as they develop.

A Split-Log Drag Club.

A split-log drag club is one of the latest organized movements for road-building in Texas.

The territory usually covered by a club, embraces about 6 miles of road, and the farmers along the route join the club, and they pay 50c. dues per month. All the money received by the club is used in defraying the expenses of running a split-log drag over the road when needed.

The Cooke County Commissioners furnish free of charge to each club a split-log drag of steel construction, which cost $25.00 to build, and the club stands the expense of operation. Cooke County now has eleven of these clubs in operation, and the results are so satisfactory that the movement is spreading rapidly throughout the entire country.

The business men of Gainesville ass'ts. in the organizations

It is quite a common occurrence for fifteen or twenty merchants and bankers to ride ten or fifteen miles in the country to attend a split-log drag meeting, and they usually join the club, lending their moral and financial support to the movement.

Dragging the Road.

In Carroll County, Missouri, an overseer has 8 miles of road to look after, and is responsible for the dragging of it. After a rain, the overseer telephones the farmers and out they go with their drags.

This is mostly done in April, May and June. The farmers are paid by a previous agreement. The cost is $10.00 to $15.00 per mile per year, including $15.00 paid each overseer. 10,000 farmers drag in front of their properties. Where there are vacant lands, special arrangements are made.

In Maine the least expense for dragging was $1.50 per mile per year, and the greatest $6.00, average $3.00. In Iowa it was $2.40 per mile per year. In Missouri, one farmer was hired to drag a 5-mile stretch. He received $3.00 per day, and at the end of the year the cost was found to be $1.66 per mile per year. This was a tough clay road. On all clay roads in Minnesota, one year's experience with the drag kept the road good at a cost of $5.00 per mile per year. In Illinois 15,000 farmers are dragging the roads. To keep the roads in an equally good condition, without the drag will cost from $34.00 to $52.00 per mile, from actual trials in 6 counties in Kansas. The drags seems to be worth while, does it not?

In Oklahoma they have once a year a Road-Building Day. It is described thus:—

"On the morning the contest was to be pulled off, nearly 2,000 teams and several thousand men were scattered along the 33 miles of the highway which was to be improved before the sun went down.

"This great army of men was made up of the well-to-do and most prosperous and progressive citizens, and every man there did his level best. A captain was in charge of each section of work which was from one-half to one mile in length, and each captain had his specifications for grades and ditches. In fact, the whole plan was so well systematized and arranged that there were no hitches, but the scheme was carried out so that each man could do the most work in the limited time.

"Each mayor of the towns in the districts affected by the building of the highway, issued a proclamation that all business houses, so far as possible, close, and the men devote the day to the upbuilding of the entire country by building this road. The suggestion was promptly complied with.

and the business men of the county vied with the laboring men as to who could do the greatest amount of work.

"The ladies furnished bountiful baskets of dinner and served a picnic dinner 33 miles long.

"Toll lines were established all along the lines, and when a traveller chanced to pass that way, unless he could give a reasonable excuse as to why he was not at work, toll to the amount of one dollar was exacted. A man caught resting on his spade or delaying his team, had his tobacco taken away from him, and if it occurred in the morning was deprived of his noon-day meal. In fact, the entire day passed with many pleasantries along with the usual day's labor. The road-building project was a decided success, and the road was completed within one day."

We need the help of the women in this road matter. Did you ever hear of a man becoming great who did not have behind him an ambitious mother or sister or wife; or did you ever hear of a man—a married man—becoming rich without first asking his wife's permission? If the Daughters of the Empire over this Dominion would simultaneously start an agitation for better roads it would help greatly in hastening the general interest in that subject, which in the next few years will be a more live question than Reciprocity or the Navy or any other political question. One of Marden's inspirational books is entitled "He can who thinks he can," and when the men and women, and the children, too, think that they can have good roads, then they will have them.

The Roadside.

The roadsides are usually left in a very unsightly condition. Trees and bushes are cut down and left to decay where they fall, or dry up and supply food for fires later. It would be an easy matter to cut the trees close to the ground and allow the grass and flowers to grow up and hide the ugliness of the surface. If a tree were left every 50 feet on each side, in alternate rows, our roadsides would soon become beautiful borders, and the roads themselves, shaded lanes, on which travel would be a delight. The C. P. R. is now supplying its station masters and track men with all the flower-seeds they want, free of charge, and giving encouragement to plant them. The result is that many of the station-grounds are beauty spots, and in many places unsightly cuttings and sliding banks are blooming with poppies

and bright flowers of many kinds. 125,000 packages of flower-seeds were sent out last spring. Thousands of shrubs, plants, perennials, bulbs, lawn-seeds, lawn-mowers and garden hose were supplied free.

The employees are writing to the Company to express their pleasure. One woman says that the place is more like "Home", and she has given several of her children flower names, such as Pansy, Verbena, etc.

That word "Home"!: how much it means to the lonely ones: the home that "Our feet may leave, but not our hearts."

Three years ago I visited an old slave plantation near the city of Savannah, where there was a driveway half a mile long, leading from the highway to the plantation residence. The road was bordered with a row of live oaks on either side, huge patriarchal giants of the olden time. It was worth a journey to see that ever-green arch of oaks towering into the air, the moss waving on their great branches and [illegible] of the low country of the south. At the end of this [illegible] and shady lane, stood the empty brick house, [illegible] once ruled as king. On one side, [illegible] little brick 10'x10' houses of the slaves. There, too, in the yard, stood the [illegible] with its iron ring 8 feet above the ground.

[illegible] Civil War many of the roads of the South [illegible] by the wheels of gun-carriages and the feet of horses and of armed men, on their way to kill each other, so that it might be once for all decided whether or not that overseer could lawfully tie the wrists of that negro to the iron ring which we just saw, and lacerate his back with a rawhide whip. Before that question was decided, the hands of time's clock (so far as the state of the country and its roads was concerned) had gone back fifty years.

Road Administration.

The administration of the road funds of any community, to be successful, must be conducted along business lines. When we consider the number of miles of roads in this country, and the amount of money and labor spent on them, we can, or should, realize that it should be carefully spent, and in accordance with business principles. In the first place, road [illegible] should be free from political influence. Secondly, men specially trained for their work are essential [illegible] successful operation. It is a common opinion that any one can build a road, and that special training is unnecessary, and yet no

man in building a house would dream of hiring painters to lay the bricks, or the bricklayers to do the painting. This is the reason statute labor is inefficient. Each man does his share of the work ignorantly and grudgingly, and is not required to have any knowledge of road construction.

A good system would be to have a highway engineer competent to pass upon any question affecting the construction or maintenance of roads, placed in charge of the road work of the Province. This engineer should be responsible for road construction; for the repair and maintenance of roads; should prepare contracts and specifications; repair and maintain bridges; have charge of all road machinery and purchase all material, and should account regularly to the Road Commissioner for all money expended under his direction. Under this engineer's immediate jurisdiction should be placed an assistant engineer for each county, a certain number of skilled road supervisors or road overseers, each having a given territory for which he would be responsible. In his territory the overseer should have direct supervision over the road gangs, and each gang should be in charge of a foreman. Under this system of organization, there would be no waste of public revenue, in ill-conducted efforts at road-building, for every item of work performed would be part of a general system, devised in the office of the highway engineer, and approved by the Commissioner.

In some States of the Union, convicts are employed at 75c per day to improve the roads, the money being put in the bank and paid over to them when they are discharged. This keeps them more content and eventually affords them a new start in the world. Property bordering on these roads has risen in value from 33 1/3 to 350 per cent. The convicts work in charge of a keeper with a magazine rifle under his arm, whose instructions are as follows: "If a fellow bolts and you miss him, you are discharged. If you kill him it is all right." Not many fellows bolt.

The prisoners of this country should be put to building highways, through which all the people benefit, and where their labor would add to the permanent wealth of the Province and the fixed value of its land.

In Colorado, by using convict labor, they make 7 miles of road for the cost of one mile. In two years, only 1 man out of 200 ran away, and he was recaptured. They are placed on their honor. By faithful work a convict can reduce a 5-year sentence one-half. It is estimated that 75

per cent. of these men can be reformed by the [illegible]orado plan, and converted into good workmen and tradesmen.

This, and several other good laws, has resulted from the work of one little woman, Kate Barnard—Oklahoma Kate they call her—who is giving her whole life to carrying out the Golden Rule in her own State.

A traveller once said to me: "West of Montreal, out of 10 Westerners in a smoking car, 9 will boost the country and one will 'knock' it. When I come East of Montreal, out of 10 Easterners 9 will 'knock' their country and one will boost it. This kind of loyalty to country has had much to do with the Western immigration. Give a dog a bad name and you may as well hang him. There is so much competition nowadays that to do anything we must talk big, and be to a reasonable extent "imaginative talkers." "It is not good policy to keep our own pigs lean."

We have to pay for roads in some way. If we do not pay for good ones, we pay for bad ones: to the blacksmith, the carpenter, the harness-maker and the horse-dealer. We do not travel over bad roads for nothing. Is our own time of no value at all? Would it not be a great advantage to have 50 per cent. more of our travelling time on the farm, to take the place of the hired man, rather than spend it ploughing through the mud on a bad road, killing our horses and breaking our wagons and harness to pieces? I tell you it would be money in our pockets to have better roads. Where all are poor, poverty is not considered as such; and where roads are all poor, they come to be looked upon as a part of nature—something that we cannot change and it were almost sacrilege to interfere with. In this matter let it be no longer said that down here in this part of the country where the day begins, that our blood flows sluggishly, and that we are slow, although we do get up earlier in the morning; and if we ever intend to put the best foot forward and live in more congenial surroundings, we cannot begin in a cheaper or better way than by improving our common roads. If it costs us more than we are paying now, let us, like Simonides "throw a chip on the water and have faith enough to believe that it will come back to us in gold." We are only passing through this world once; and before the grim reaper comes, let us have the pleasure of travelling over a good road once in a while, even if we do issue bonds and have our children bear a share of the burden.

They must be, comparatively speaking, short-term bonds though, and we must do for the money such work as reducing grades, filling low places, draining, building retaining walls and making durable foundations. Then, when this is done only the wearing surface of the road will have to be maintained by an annual appropriation added to the auto taxes and licenses. If we simply attend only to the wearing surface of our roads with the borrowed money, our children will be paying for something which was worn out before the debt became due—dead horse. As a general principle, the term of a loan should never be longer than the life of what the loan procures.

Bond Issues.

If the collective public can borrow money at a lower rate of interest than its individual members can earn upon their individual capital, then it is more economic to bond for public improvements than to pay for them direct.

Rockefeller has stated that one of the chief reasons for his early success was his ability to borrow money.

The real danger in public borrowing lies not in the obligation incurred—not in the bugaboo of interest and sinking fund annuities—but in the exercise of poor judgment by those who are entrusted with the investment of money in public improvements.

The true economic question is merely whether the reduced cost of hauling over the improved road is sufficient to offset its upkeep cost, and the interest on the investment.

How to maintain good roads is a more serious problem than how to build them. The best macadam road, without care, will only last ten years. The maintenance will date from the second year and will cost 2 per cent. per annum of the first cost, and the administration costs about 5 per cent. of all road expenditures. The highway commission and the road engineers should be free of political control and should remain in office during good behavior.

Road Patrol.

For the maintenance of the State roads of Minnesota, for the last three years they have had a patrol system where one man has charge of six miles of road His equipment is:—A brass plate on his hat, carrying the words "State Road Patrol." His tools are:—a wheelbarrow, rake, shovel, pick, scythe, axe, etc.

His pay is $55.00 per month from April 1st to November 15th, and he must see every part of his section at least once in two weeks.

The county or town provides a driver and team to haul a split-log drag, and material to fill holes when needed. Piles of material are deposited at convenient points for general repairs.

His duty is to give the road "The stitch in time" and keep busy, and there are usually enough travellers to see that he does so.

The wave of Canadian immigration has now touched the Pacific ocean, the icy north on one side, and the international boundary on the other side. What can be the direction of the receding wave and the undertow, but back towards the rising sun?

"Opportunity knocks once at every man's door," and the hand of opportunity is even now on the door-knocker of these Provinces by the sea. Let us by improving our roads, help opportunity to enter, and give us a hand in developing the varied natural resources of the land and of the salt sea which beats upon our shores.